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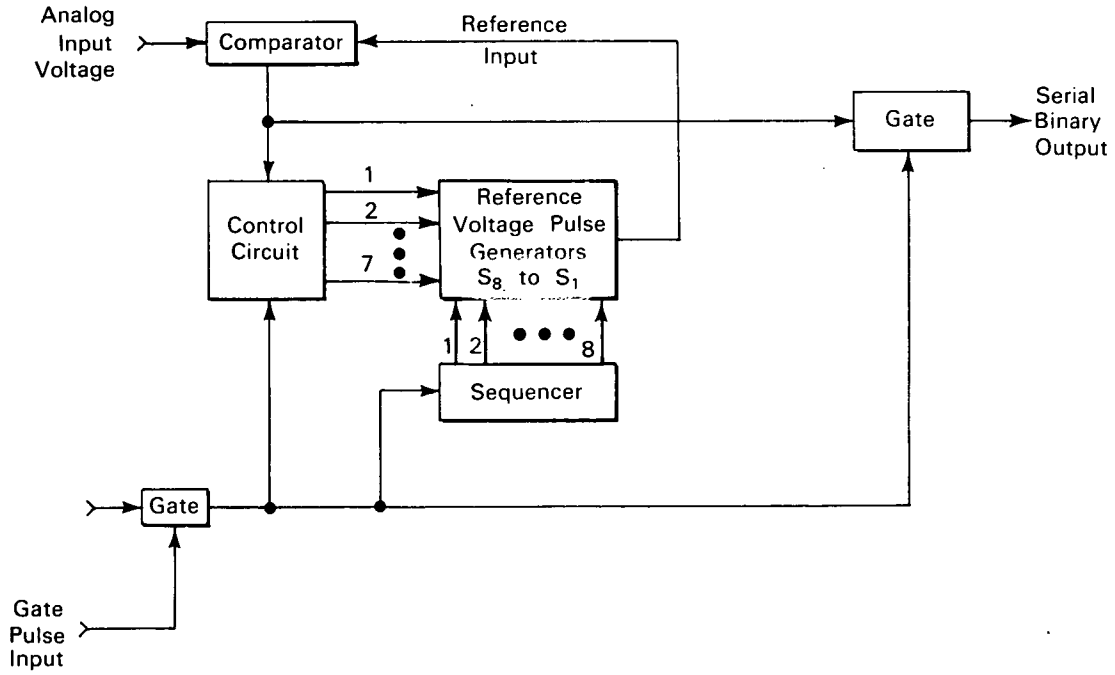
NASA TECH BRIEF

Analog-To-Digital Converter Has Increased Reliability and Reduced Power Consumption



The problem: Decreasing average power consumption and increasing component reliability in analog-to-digital converter circuits.

The solution: An eight-bit analog-to-digital converter, which uses solid-state components in pulse operation to minimize average power consumption and magnetic core components to increase reliability and minimize average power consumption.

How it's done: The input gate pulse allows eight 400-cps clock pulses to be applied to the memory control circuit, the sequencer, and the output gate in order to time and control the formation of the binary number. The sequencer triggers the reference pulse generators sequentially from S_8 to S_1. The output from the reference pulse generators is applied to the comparator, where the amplitude of the reference voltage pulse is compared to the amplitude of the analog voltage input. If the analog voltage amplitude is greater than the reference voltage amplitude, there is no comparator output, a "1" is formed at the binary output, and the memory control circuit triggers that particular reference pulse generator for the remainder of the eight clock pulses. That particular reference output is

(continued overleaf)

therefore summed with each of the remaining reference pulse outputs as they are sequentially triggered by succeeding clock pulses (i.e., $S_8 + S_7$, $S_8 + S_6$, ... $S_8 + S_1$). A "0" is formed at the binary output when the analog amplitude is less than the reference amplitude and the particular reference generator is not held.

All of the circuits shown on the diagram are pulse type except for the output gate, the comparator, and a flip-flop in the sequencer circuit. The memory control circuit uses a nonlinear core transformer combined with a linear core transformer in a one-shot blocking oscillator circuit. The nonlinear core transformer acts as the memory element, and the blocking oscillator acts as a delay element and places the nonlinear core transformer in the proper state of operation. The reference pulse generators are blocking oscillators using nonlinear transformer cores. The sequencer circuit is similar to a ring counter, in which a single input pulse is transferred from core to core, so that the output of each core is used to trigger a reference pulse generator. The use of magnetic core components increases reliability both through the inherent reliability of magnetic core components, and by reducing the number of components required. Average power consumption is reduced by the use of blocking oscillators, which are in a cutoff state part of the time, instead of flip-flops, which always have one component conducting.

Notes:

1. This invention should be of interest to companies that manufacture analog-to-digital converters.
2. Applications of this invention will be limited by its rate of operation requiring 200 microseconds to form one binary word.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10194

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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